

# Exploiting Models of Personality and Emotions to Control the Behavior of Animated Interactive Agents

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## Introduction

The German Research Centre for Artificial Intelligence (DFKI) recently started three new projects<sup>1</sup> to advance our understanding of the fundamental technology required to drive the social behaviour of interactive animated agents. This initiative has been timed to catch the current wave of research and commercial interest in the field of lifelike characters [1] and affective user interfaces [14,20]. The Puppet project promotes the idea of a virtual puppet theatre as an interactive learning environment to support the development of a child's emotional intelligence skills. The second project features an Inhabited Market Place in which personality traits are used to modify the characters' roles of virtual actors in sales presentations. The Presence project uses an internal model of the agent's (and possibly the user's) affective state to guide the conversational dialogue between agent and user. Although all three projects rely on a more or less similar approach towards modelling emotions and personality traits, there are variations with regard to the underlying user-agent(s) relationship(s), the factors that influence an agent's emotional state, the complexity of the underlying model of emotions and the way in which emotions and personality traits are made observable.

## Models of Personality and Emotion

One of the first challenges we must face when attempting to use *affect* within our architectures, is to recognise the fact that the term does not refer to a well-defined class of phenomena clearly distinguishable from other mental and behavioural events. Affect is used within the literature to describe the class of motivational control states which result from valenced reactions to objects and events - these include emotions, mood, and arousal. Therefore the only generalisation we can really make about affect is that it must contain at least the two attributes of activation and valence. The different classes of *affective states* can further be differentiated by *duration*, *focus*, *intensity*, and *expression/effect* - emotions tend to be closely associated with a specific event or object and have a short duration, whereas mood is more diffuse and of longer duration. Within the context of this paper, we define *personality* as "the complex of characteristics that distinguishes an individual or a nation or group; especially the totality of an individual's behavioural and emotional characteristics", and *emotion* as "affect that interrupts and redirects attention (usually with accompanying arousal)" [18].

Although there is no consensus in the nature or meaning of *affect*, existing theories and models of personality and emotion can still play a useful role in enhancing user-agent interaction - even though they do not capture the *affective* phenomena in its entirety. As a starting point for our work, we have taken the Five Factor Model (FFM) [12] of personality, and the Cognitive Structure of Emotions model (OCC - Ortony, Clore and Collins) [13]. These models are readily amenable to the intentional stance, and so ideally suited to the task of

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<sup>1</sup> The Puppet Project is funded by the European Community within the i3-ese programme (Experimental School Environments) and started in October 1998. Our project partners are: the University of Aalborg, Denmark, (Laboratory of Image Analysis), the University of Aarhus, Denmark, (Institute of Dramaturgy) and the University of Sussex, UK, (School of Cognitive and Computer Science). Presence is financed internally by the DFKI. The Inhabited Market Place is funded by the BMBF (Bundesministerium für Bildung und Forschung).

creating concrete representations/models of personality and emotions with which to enhance the illusion of believability in computer characters.

*Emotions:* The OCC model of emotions provides a classification scheme for common emotion labels based on a valence reaction to events and objects in the light of agent goals, standards, and attitudes. The OCC model is a model of causation, and will be used within both Presence and Puppet to determine the affective state of the character in response to events in the environment (see also [5] and [15]).

*Personality:* The FFM is a purely descriptive model, with the five dimensions (*Extraversion*, *Agreeableness*, *Conscientiousness*, *Neuroticism*, and *Openness*) being derived from a factor analysis of a large number of self- and peer reports on personality-relevant adjectives. The descriptive nature of the FFM gives us an explicit model of the character's personality, and in turn, allows us to concentrate on using the affective interface to directly express those traits (which offers the interesting possibility of attempting to recreate the character's personality traits from an analysis of the emergent social interaction). Furthermore, as we are focusing on social interactions, we can concentrate on the traits of *extraversion* (Sociable vs. misanthropic; Outgoing vs. introverted; Confidence vs. timidity) and *agreeableness* (Friendliness vs. indifference to others; A docile vs. hostile nature; Compliance vs. hostile non-compliance) - although we will also use *neuroticism* (Adjustment vs. anxiety; Level of emotional stability; Dependence vs. independence) to control the influence of emotions within our characters.

In addition to generating *affective states*, we must also express them in a manner easily interpretable to the user (which in the case of the Puppet project will be young children). Personality and emotions can be conveyed in various ways. According to empirical studies, extravert characters use more direct and powerful phrases than introvert characters [6], speak louder and faster [17] and use more expansive gestures [7]. Furthermore, the rendering of dialogue acts depends on an agent's emotional state. Effective means of conveying a character's emotions include acoustic realisation, body gestures and facial expressions [4]. While these studies seem directly applicable to anthropomorphic agents like the Presence Persona, it is not clear to what extent they apply to animals with anthropomorphic features such as the characters in the Virtual Puppet theatre.

In all three projects, personality and emotions are used as filters to constrain the decision process when selecting and instantiating the agent's behaviour. For instance, we might define specific behaviours for extravert characters in a certain emotional state. However, there are other (affective) states we would like to convey that are not simply the result of an affective appraisal (as in the OCC model), or easily derived from personality traits - i.e. fatigue, boredom, and hunger. To model these states, we mimic our character's active body state with motivational drive mechanisms to provide the affective input signals.

## **The Role of Affect and Personality in Puppet**

The objective of the Puppet project is to develop and investigate the value of a new virtual reality environment, the Virtual Puppet Theatre, based on a theoretical framework of "learning through externalisation" [16]. For our first prototype developed for children at the age of 5-6, we decided to model a farmyard as a co-habited virtual world, in which the child's avatar (e.g. the farmer) and a set of synthetic characters (pigs, cows, etc.) can interact with each other. Fig. 1 shows a screenshot of the virtual 3D environment which was developed by our project partners from the Laboratory of Image Analysis at the University of Aalborg.

Deploying user-controlled avatars and synthetic characters in the child's own play production, the children have to distinguish and master multiple roles in their interaction with

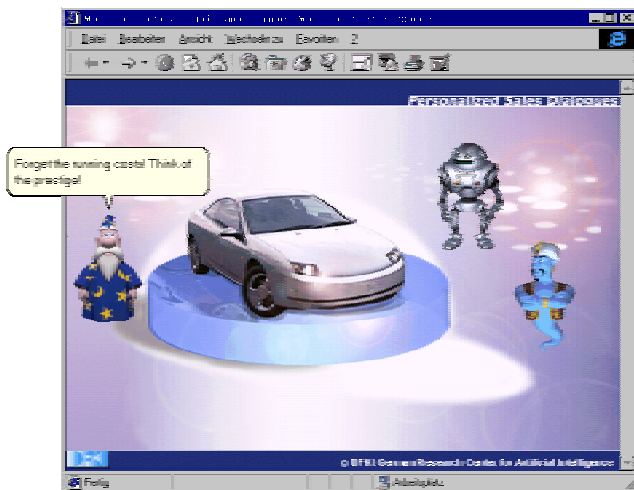


**Fig. 1.** Puppet 3D Environment

the children's emotional intelligence skills will be improved by constructing simple models of the virtual puppets minds.

the system, e.g. that of a director, an actor and an audience with the main activities producing, enacting and reflecting respectively. Within this process the children should gain a basic understanding on how different emotional states and personality profiles influence a character's behaviour and how physical and verbal actions in social interaction can induce emotions in others. Our approach is similar to [8] which allows children to direct a puppet's mood, actions and utterances in interactive story-making and to [11] where children may induce changes in the characters' emotional state besides selecting a character's actions. Over the next few months, our project partners at COGS will evaluate a group of 5-6 year old children before and after they played with the VPT. We hope that their findings will validate our assumption that

### The Role of Affect and Personality in The Inhabited Market Place

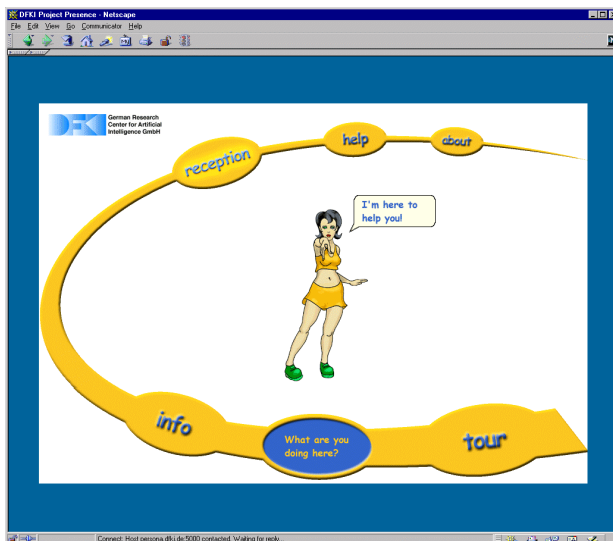


**Fig. 2.** Inhabited Market Place.

The objective of the Inhabited Market Place is to investigate sketches, given by a team of lifelike characters, as a new form of sales presentation (cf. Fig. 2). The basic idea is to communicate information by means of simulated dialogues that are observed by an audience. The main feature of the generated presentations is that the characters not only communicate plain facts about a certain subject matter but present them from a point of view that reflects their specific personality traits, emotions and interest profiles. The purpose of this project is not to implement a more or less complete model of personality for characters.

Rather, the demonstration system has been designed as a testbed for experimenting with various personalities and roles. First informal system tests were encouraging. Even though it was not our intention to make use of humour as e.g. the authors of the Agneta & Frida system [9], people found the generated dialogues entertaining and amusing. Furthermore, people were very eager to cast the agents in different roles in order to find out the effect this would have on the generated presentations.

## The Role of Affect and Personality in Presence



**Fig. 3.** Presence Prototype.

(text, pictures, videos and speech) devices; (b) the development of a high-level descriptive language for character definition, based on personality traits to allow easy customisation of the agent; (c) the combination of computational models of personality and emotion with planning techniques to guide the interaction of a lifelike character presenting material to visitors both locally and/or remotely over the world wide web; and (d) explore the possibility of tailoring the agent-user interaction to an individual user by inferring the user's affective state.

## Conclusion

Although all three projects use the same basic psychological models for personality and emotions, they differ in the types of implementation strategies adopted - reflected by the different requirements of their respective application domains. In Puppet and the Inhabited Market Place, we explicitly hand code personality style and affective responses centrally, within the presentation plans themselves. In these scenarios, we do not deal with emotion structures and emotion generating rules explicitly (e.g., see [5]), but rather connect the scenario-specific dialogue acts (e.g., DiscussValue, PositiveResponse, InformIf) to the relevant animation sequences and utterance templates by using the current internal state of the character as an additional constraint in the behaviour selection mechanism. This approach is similar to that of Lester and colleagues [10], where pedagogical speech acts drive the selection and sequencing of emotive behaviours. It allows us to rapidly prototype our presentations, taking advantage of a domain that is more or less self-contained. The approach seems appropriate for applications which address the generation of highly stereotypic response patterns for simpler emotion types. For example, in the Puppet project, we want to send clear and reproducible affective signals to the children who play with the system. In Presence, we made the conscious decision to clearly separate the affect modelling process from the more general purpose presentation planning process. This allows us to maintain a fairly complex, and yet consistent, model of our agent's affective state over a number of very different dialogue topics and application domains - and still produce an engaging variety of responses at the output stage.

A more detailed description of the Inhabited Market Place provides [3]. For further information on the Puppet and the Presence projects, see [4].

The Presence project uses lifelike characters as virtual receptionists/info-tainers/ accompanying guides for visitors to DFKI (see Fig. 3). Here we intend to explore the hypothesis that using an explicit affective model (of both agent and user) to guide the presentation strategies used in the human-agent conversational dialogue will (a) create a more natural and intuitive user interface (by tailoring the conversation to an individual person); (b) provide the user with an engaging and enjoyable experience; and (c) enhance the believability of virtual characters. The Presence project addresses the following research goals: (a) the flexible integration of multiple input (speech, mouse, keyboard and touch-screen) and output

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